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Stability of the DSI Electromagnetic Update Algorithm on a Chevron Grid

S. T. Brandon and P. W. Rambo
University of California, Lawrence Livermore National Laboratory
P. O. Box 808, Livermore, CA 94550

The discrete surface integral (DSI) algorithm [1] for solving the Maxwell curl equations in the time domain provides the opportunity to accurately discretize extremely complex geometries. This algorithm is a direct generalization of the standard staggered-grid finite-difference approach using a 3d, non-orthogonal,unstructured grid composed of mixed-polyhedral elements. Little is known about the numerical properties of the DSI method when discretized on these more general grids. However, dispersion characteristics can be determined for idealized non-orthogonal grids which provide some insight on the behavior of the algorithm on more general grids. Results of the dispersion and stability analysis for the DSI algorithm when discretized on a 2d chevron grid will be presented. This analysis shows that, for chevron grids, the DSI algorithm supports slowly growing electromagnetic oscillations. Unlike the usual Courant instability, these oscillations have complex frequencies with nonzero growth rates for a vanishing time step.Several numerical examples of the chevron instability, along with some comments about the possible impact of this instability on real problems will be presented.

Acknowledgments

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References

[1] N. K. Madsen, "Divergence Preserving Discrete Surface Integral Methods for Maxwell's Curl Equations Using Non-Orthogonal Unstructured Grids," UCRL-JC-109787 (February 1992) and submitted to J. Comput. Phys.